معن سلام قعدان [redacted]

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امتحانات دائمي ١٠ - ١١

60/70

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Mid Term Test 1. 2011 – 2010 الفصل الثاني Dynamics

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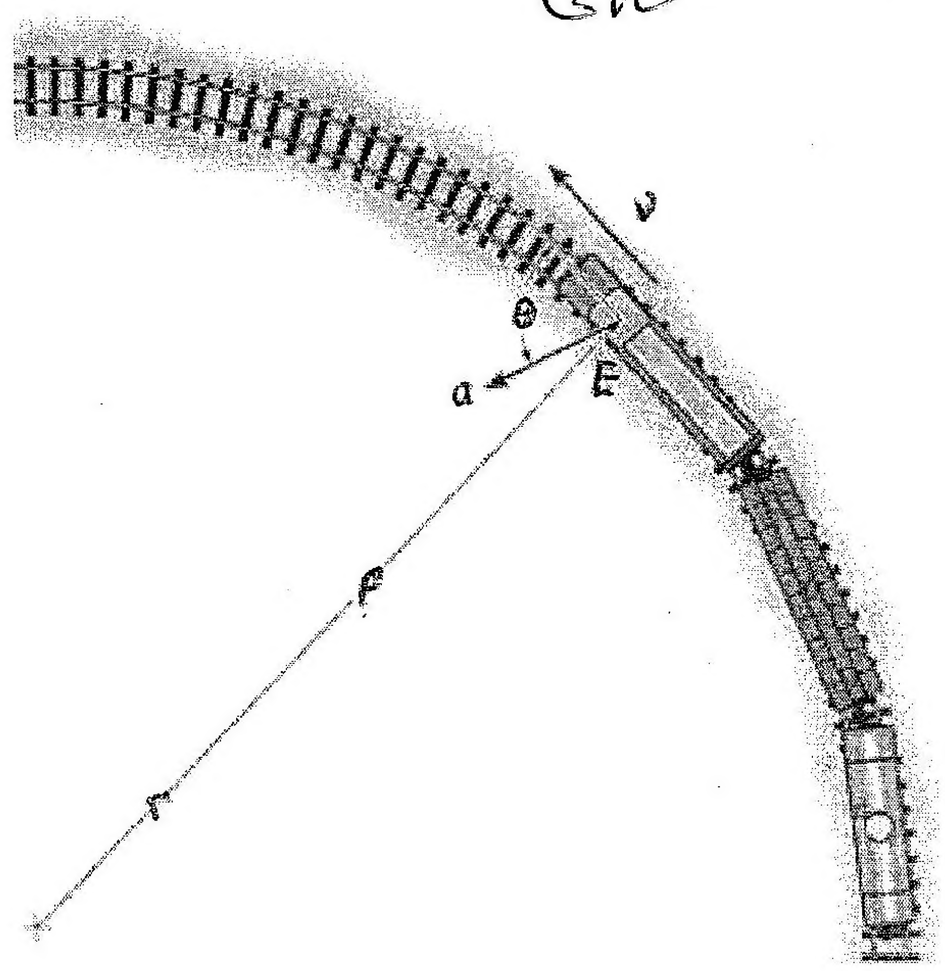
Good.

Section A – Answer both questions from this section

QA1

At a given instant the train engine at E has speed (v = 35 m/s) and acceleration a = 18 m/s^2, acting in the direction shown with θ = 70 °.



Determine

The train's acceleration in the tangential and normal directions(a_t and a_n)and the radius of curvature (ρ) of the path at his instance.

Choose one of the following answers:

a) a_t = 8.26 m/s^2, a_n = 18.75 m/s^2, ρ = 70.52 m

b) a_t = 4.26 m/s^2, a_n = 13.95 m/s^2, ρ = 74.37 m

c) a_t = 6.16 m/s^2, a_n = 16.91 m/s^2, ρ = 72.42 m

d) a_t = 5.56 m/s^2, a_n = 11.9 m/s^2, ρ = 62.48 m

e) None of the above [5 marks]

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Ans. [10 marks]

[redacted] $a_t = 18\cos 70^\circ =$ 6.16 m/s^2

$a_n = \frac{v^2}{\rho} \Rightarrow a_n = 18\sin 70 =$ 16.91 m/s^2

$\therefore a_n = 16.91 = \frac{(35)^2}{\rho} \Rightarrow \therefore \rho = \frac{(35)^2}{16.91} =$ 72.4 m

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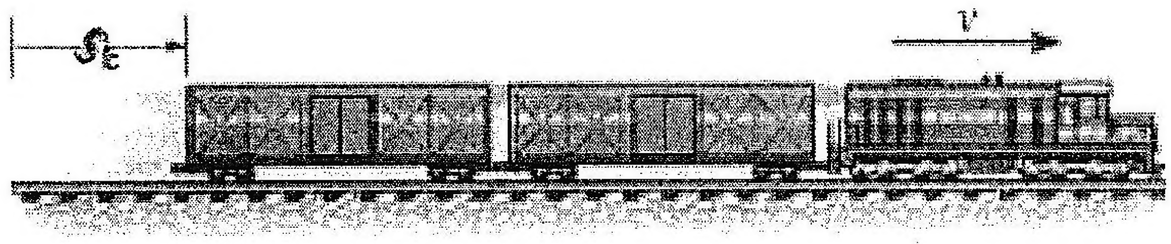
QA2

A freight train travels at $v = v_0(1 - e^{-bt})$, where (t) is the elapsed time. Determine the distance travelled in 3 seconds, and the acceleration at this time, given that v_0=20 m/s and b=1/s



Choose one of the following answers:

a) d =53 m, a = 1.6 m/s²

b) d =41 m, a = 1.0 m/s²

c) d =63 m, a = 1.9 m/s²

d) d =35 m, a = 2.3 m/s²

e) None of the above [5 marks]

Ans. [10 Marks]

$V = V_0(1 - e^{-bt})$

$\therefore V = 20(1 - e^{-t}) = \boxed{20 - 20e^{-t}}$

$a = \frac{dV}{dt} = 0 + 20e^{-t} = \boxed{20e^{-t}}$

$\therefore a(t=3) = 20e^{-3} = \frac{20}{e^3} = 0.995 \approx \boxed{1.0\ m/s^2}$

$x = \int V(t)\,dt = \int_0^3 20 - 20e^{-t}\,dt$

$= \boxed{20t + 20e^{-t} + C}$?

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How?

$\therefore x(t=3) = 20(3) + 20e^{-3} + C$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

$20t + 20e^{-t} + C = v_0 t + \frac{1}{2}at^2$

$20(3) + \frac{1}{2}(1)(9)$

$60 + 4.5 = 64.5$

$\therefore x(t=3) = 20(3) + 20(e^{-3}) + C$

$= 60 + 1 + C$

but $C = -20$ $\Rightarrow x = 61 - 20 = \boxed{41\ m}$

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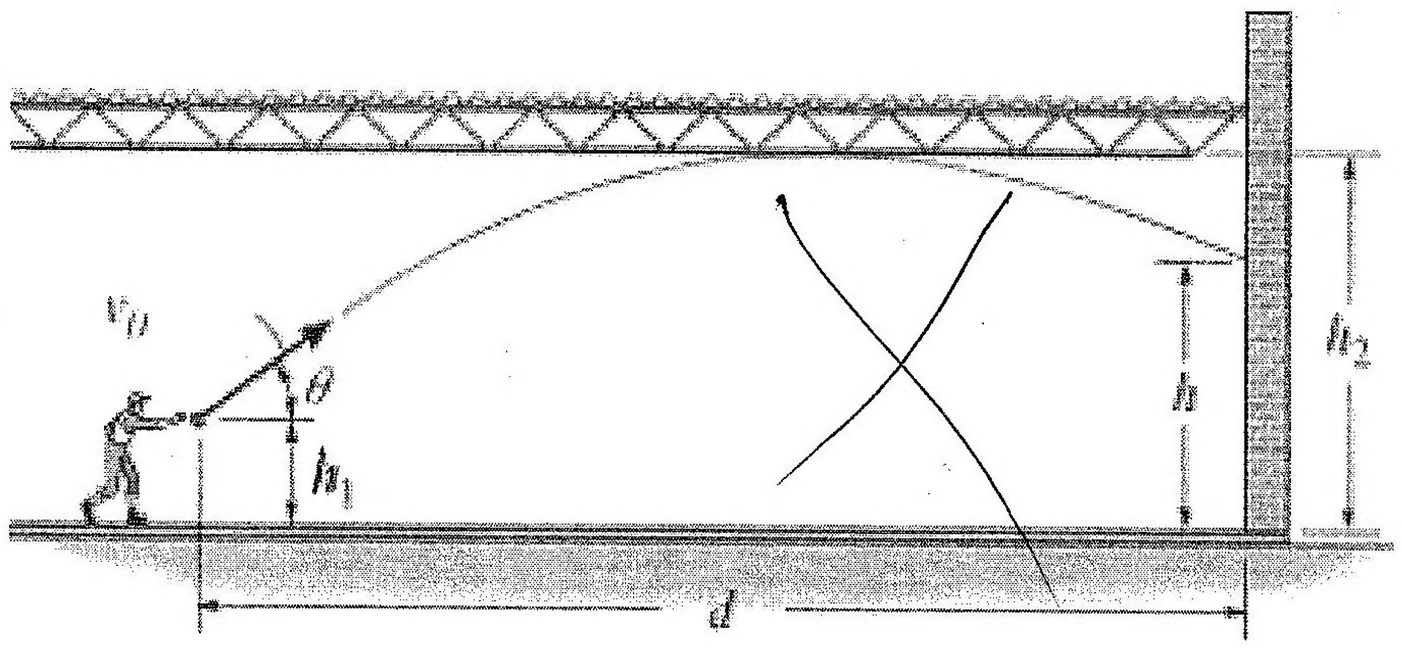
Section B – Answer 2 questions only from this section

QB1

A player whose height h_1 = 1.75 m, stands a distance d=20 m from the wall and throws a ball at it with a speed v_0 = 15 m/s. If the room has a ceiling height h_2 = 5 m, determine the following:

(i) The angle θ at which the player should release the ball so that it strikes the wall at the highest point possible. [10 marks]

(ii) The highest point possible (h)? [10 marks]



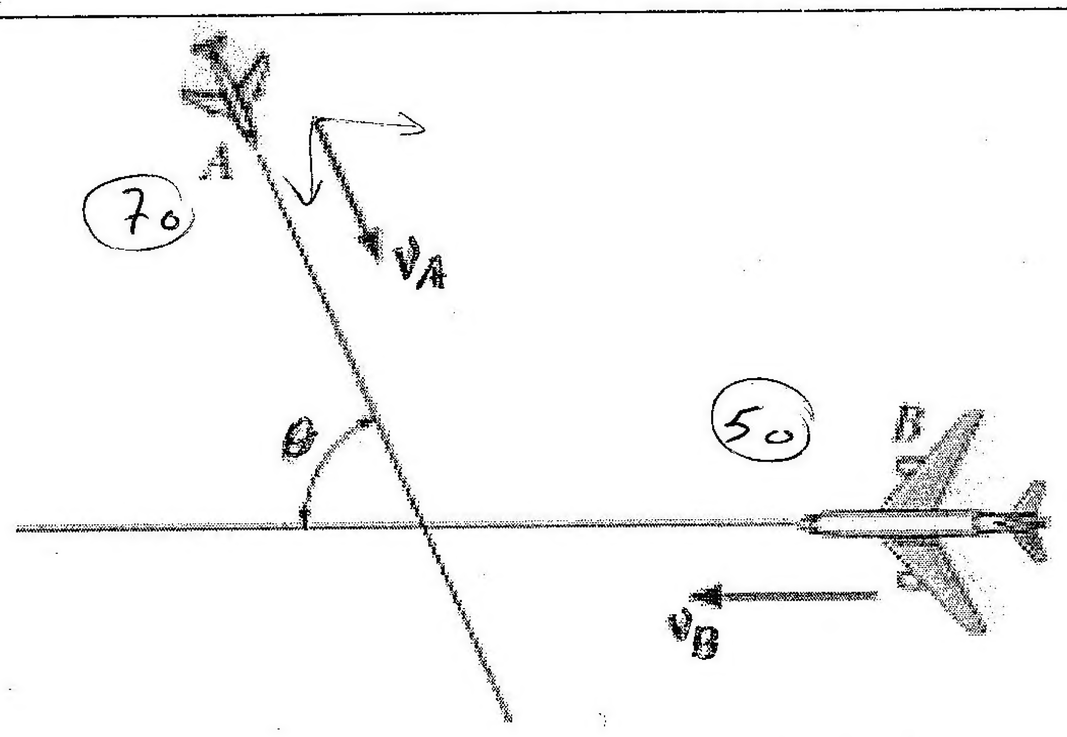
Ans.

القسم الثاني (B) يكون عبارة عن (3) اسئلة، تستطيع حلّ أيّة اثنين وترك ثالث.

انا قمت بترك هذا السؤال، وقمت بحل السؤالين الثانيين

QB2

Two planes, A and B, are flying at the same altitude such that the angle between their straight-line courses is $\theta = 60°$. Their initial positions from the intersection point 'O' are given by: OA = 70 km and OB = 50 km. If their velocities are uniform and are given by: $v_A = 700$ km/h and $v_B = 500$ km/h , determine



a) The velocity of plane A with respect to plane B (as a vector and also its value) [10 marks]

b) The displacement of B with respect to A after 10 seconds, assuming both planes stay on their respective courses) [10 marks]

Ans.

$V_A = 700\cos 60\, i - 700 \sin 60\, j$

$= 350\, i - 606.2\, j$ km/h

$V_B = -V_B\, i = -500\, i$ km/h

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[a] $\therefore V_{A/B} = V_A - V_B = (350\, i - 606.2\, j) - (-500\, i)$

$= 350\, i - 606.2\, j + 500\, i$

$= 850\, i - 606.2\, j$

$|V_{A/B}| = \sqrt{(850)^2 + (606.2)^2} = 1044.02$ km/h

[b] $X_{B/A} = X_B - X_A$

$X_B = X_0 + V_B t + \frac{1}{2} a t^2 = 50 + (500 \times 10) + 0 = 5050$ km

This is seconds which needs to be converted

$X_A = X_0 + V_A t + \frac{1}{2} a t^2 = 70 + (700 \times 10) + 0 = 7070$ km

$\therefore X_{B/A} = X_B - X_A = 5050 - 7070 = -2020$ km

3+1/10 for efforts

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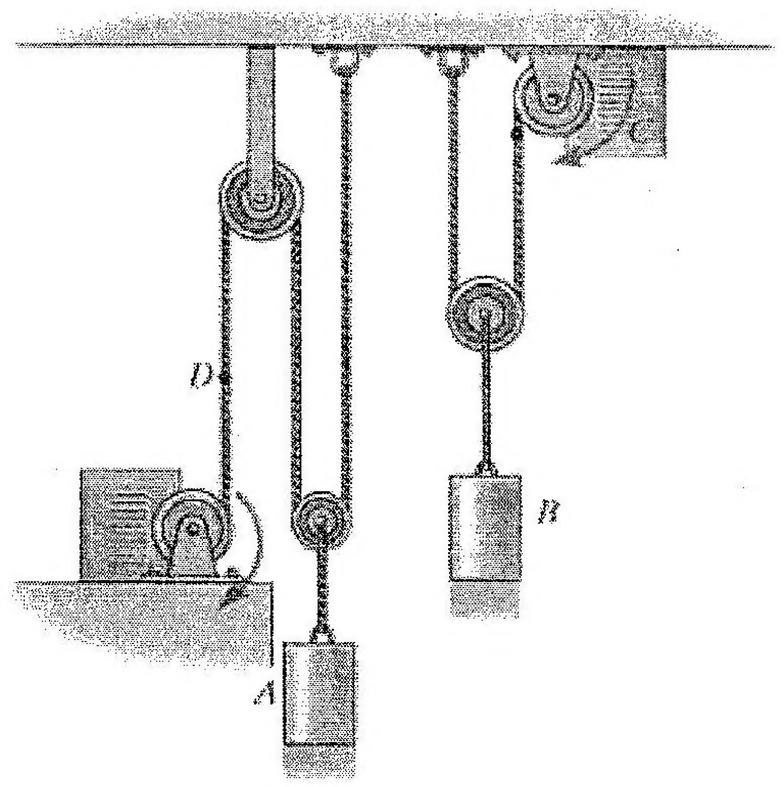
QB3

The pulley system below consists of 3 frictionless pulleys of negligible weights. The system is driven by two electrical motors at C and D. The motor at C draws in the cable with a constant velocity v_C.= -4 m/s while the motor at D draws in the cable D with a constant acceleration of a_D=8 m/s² If v_D = 0 when t = 0, determine:

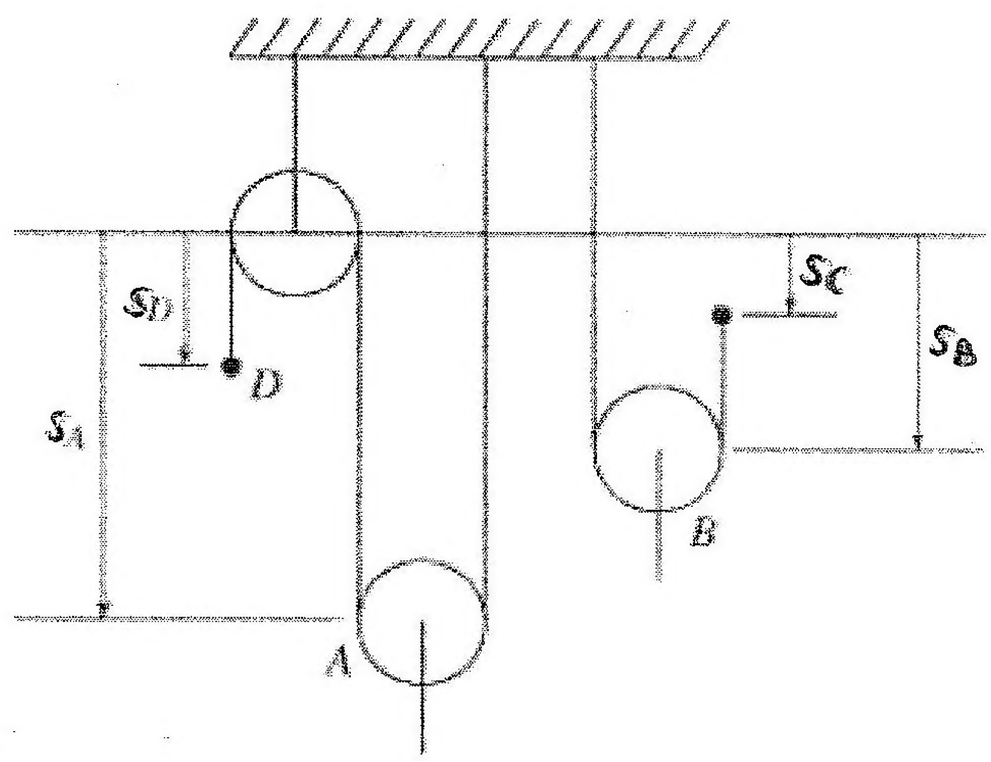


a) The time needed for block A to rise a distance of 5 m, and [10 marks]

b) The relative velocity of block A with respect to block B when this occurs.

[10 marks]

[Hint: you may use the schematic diagram shown aside]



$L_1 = 2S_A + S_D = \text{constant}$

$L_2 = 2S_B - S_C = \text{constant}$

$\therefore 2V_A + V_D = 0$

$\therefore 2V_B - V_C = 0$

$2a_A + a_D = 0$

$2a_B - a_C = 0$

$V_C = -4$ m/s

$a_D = 8$ m/s²

$V_D = 0$

$t = 0$

[a] $2a_A + a_D = 0 \Rightarrow 2a_A + 8 = 0 \Rightarrow 2a_A = 8 \Rightarrow a_A = \frac{8}{2} = 4$ m/s²

$X_A = X_0 + V_0 t + \frac{1}{2} a t^2$

$-5 = 0 + 0 + \frac{1}{2}(4) t^2 \Rightarrow 5 = 2t^2 \Rightarrow t^2 = 2.5 \Rightarrow t = 1.58$ sec

Coincidental answer

[b] $V_A = V_0 + at \Rightarrow V_A = 0 + 4(1.58) = 6.32$ m/s

$2V_B - V_C = 0 \Rightarrow 2V_B - (-4) = 0 \Rightarrow 2V_B = -4$

$\Rightarrow V_B = \frac{-4}{2} = -2$ m/s

$V_{A/B} = V_A - V_B = 6.32 - (-2) = 6.32 + 2 = 8.32$ m/s

A/QA1 8/10

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